COMPUTATIONAL PERFORMANCE OF ARTIFICIAL IMMUNE SYSTEM-BASED SIZING TECHNIQUE FOR GRID-CONNECTED PHOTOVOLTAIC SYSTEM

RESEARCH MANAGEMENT INSTITUTE (RMI)
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM, SELANGOR
MALAYSIA

BY :

ISMAIL MUSIRIN
SHAHRIL IRWAN SULAIMAN
TITIK KHAWA ABDUL RAHMAN
SULAIMAN SHAARI
AHMAD MALIKI OMAR
MUHAMMAD MURTHADA OTHMAN
KHAIRUL SAFUAN MUHAMMAD

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Contents

2. Letter of Offer (Research Grant)

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Prof. Madya Dr. Ismail Musirin
Fakulti Kejuruteraan Elektrik
Universiti Teknologi MARA
40450 Shah Alam

Y. Bhg. Prof/Prof. Madya/Dr./Tuan/Puan

KELULUSAN SKIM GERAN PENYELIDIKAN FRGS FASA 01/2010

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Dengan hormatnya perkara di atas adalah dirujuk.

Sukacita dimaklumkan pihak Kementerian Pengajian Tinggi melalui surat JPT.S(BPKI) 2000/011/010 Jilid. 2 (19) telah meluluskan cadangan penyelidikan Prof/Prof. Madya/Dr./Tuan/Puan untuk di biayai di bawah Skim Geran Penyelidikan Fundamental (FRGS) Fasa 1/2010.

Bagi pihak Universiti kami mengucapkan tahniah kepada Prof/Prof. Madya/Dr./Tuan/Puan kerana kejayaan ini dan seterusnya diharapkan berjaya menyiapkan projek ini dengan cemerlang.

Untuk tujuan mengemaskini, pihak Prof/Prof. Madya/Dr./Tuan/Puan adalah di minta untuk menyusun perancangan semula bajet yang baru seperti yang diluluskan. Sila lihat lampiran bagi tatacara tambahan untuk pengurusan projek.

Sekian, harap maklum.

"SELAMAT MENJALANKAN PENYELIDIKAN DENGAN JAYANYA"

Yang benar

MUSTAFAR KAMAL HAMZAH
Ketua INFOREC
Merangkap Ketua Penyelidikan (Sains & Teknologi)

/RS...

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Penolong Pentadbiran : 603-5544 2090
Fax : 603-5544 2096/2767
Unit Kewangan Zon 17 : 603-5544 3404 : 603-5521 1386

Research Management Institute (RMI) Universiti Teknologi MARA, 40450 Shah Alam, Malaysia
http://www.rmi.uitm.edu.my

5. Report

5.1 Proposed Executive Summary

In grid-connected photovoltaic system (GCPV) operation, the solar energy generated by the photovoltaic (PV) array is directly used to supply the load demand and the excess energy is exported to the utility grid via an inverter. Although the GCPV systems have become popular in Malaysian residential power systems, the optimal design of GCPV system is still an issue to the local GCPV system integrator. The design process commonly known as sizing process is a very important aspect in GCPV system design as the performance of the sizing components are heavily influenced by inconsistent solar radiation, ambient temperature and wind speed [A. Mellit et. al., 2009]. An undersized or oversized GCPV system could either increase the overall system cost or degrade the performance of the GCPV system (Kil et. al., 1994). Previously, J.D. Mondol et. al. (2009), S. Islam et. al. (2003) and Van der Borg (2003) and J.D. Mondol (2006) had investigated the optimal GCPV system design using both empirical and procedural techniques. As these conventional sizing techniques are tedious and time-consuming, an Artificial Immune System (AIS)-based sizing algorithm is proposed to improve the conventional sizing technique by improving the computation time and the flexibility of the design process. As AIS is proven be a better optimization technique compared to other evolutionary techniques due to its clonal operation, the proposed AIS-based sizing algorithm is expected to produce faster computation time and able to handle more design options design decision is made. It is aimed to produce a GCPV design that could maximize the inverter-to-PV array sizing ratio by selecting the optimal PV module and inverter from a pre-developed databases as well as to determine the optimal PV module mounting orientation for a given roof space.

5.2 Enhanced Executive Summary

Conventional design technique for Grid-Connected Photovoltaic (GCPV) system is usually procedural based. The design process is commonly performed using pre-selected type of PV module and inverter. As a consequence, the design may not be optimal as there are many possible combinations of PV module and inverter that could produce better optimal solution. Besides that, GCPV system design is often conducted through manual calculation or standard conventional software available in the market [1]. However, these methods are found to be very time-consuming and tedious especially when there are many possible solutions and design criteria to be considered. Therefore, an evolutionary sizing technique is required to accelerate the GCPV system design. The objective of this study is to develop an intelligent sizing technique for GCPV system using Artificial Immune System (AIS). AIS performed better than the conventional iterative method in terms of total computation time. However, this project only considers GCPV systems with single-string inverters. Multiple string inverters are excluded from the project. In addition, AIS also produced competitive design solutions and shorter computation time when compared with iterative sizing method and selected computational intelligences such as Genetic Algorithm (GA) and Particle Swarm Optimization (PSO).

5.3 Introduction

As the global depletion of the conventional fuel resources becomes rampant, the search of the alternative energy resources has been more extensive. One of the alternative energy resources is the solar energy. The solar energy, which is renewable in nature, is now used to generate solar electricity through photovoltaic (PV) system. A PV system typically consists of several PV modules, charge storage units and power conditioning units, depending on the loads. If the PV system is connected to the grid-network, the PV system is specifically known as a Grid-Connected Photovoltaic (GCPV) system. Besides switching and protection devices, a GCPV system usually consists of PV modules to convert solar energy into DC electricity as well as inverters to convert the DC electricity to AC electricity which will be later exported to the utility grid. The solar electricity exported to the grid would cause a reduction of the monthly electricity bills or a net profit if the exported solar electricity is larger than the electricity consumption from the grid. In addition, a GCPV system owner could still obtain the electricity from the grid if there is no power generated by the system. Thus, the system offers an attractive mode of